JAPANESE PATENT OFFICE (JP)

PATENT JOURNAL (A)

KOKAI PATENT APPLICATION NO. HEI 4-131835

Int. Cl.[5]:	G 03 B 21/62
Identification code:	
Sequence Nos. for Office Use:	7316-2K
Application No.:	Hei 2-253742
Application Date:	September 21, 1990
Publication Date:	May 6, 1992
No. of Inventions:	3 (Total of 9 pages)
Examination Request:	Not requested

METHOD AND DEVICE USED FOR PRODUCTION OF LENS SHEET

[*Renzu shiito no seizoh houhoh oyobi sono seizoh souchi*]

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[*There are no amendments to this patent.*]

Specification

1. Title of the invention

Method and device used for production of lens sheet

2. Claim of the invention

(1) The production of a lens sheet having a reverse release portion where the molding tool is engaged with lens sheet when the lens sheet molded by the molding tool is peeled from the molding tool in a constant direction by flexing the lens sheet, which production of a lens sheet is characterized by the fact that lens is peeled from the mold tool utilizing curvature of the molding tool for the above-mentioned reverse release portion of the lens sheet.

(2) In the production of a lens sheet having a reverse release portion where the molding tool is engaged with the lens sheet when the lens sheet molded by the molding tool is peeled from the molding tool in a constant direction by flexing the lens sheet, production of a lens sheet characterized by the fact that the method consists of

a resin coating process wherein an ionizing radiation curing resin is coated in the gap of a lens molding tool having curvature in at least one area,

a lens molding process wherein ionizing radiation is applied to the above-mentioned ionizing radiation curing resin to cure the resin and molding of the above-mentioned lens sheet is achieved,

a release process wherein the above-mentioned lens sheet is released as flexing of the sheet is performed, and the lens sheet is released from the curved side of the above-mentioned molding tool in such a manner that curvature on the side of the above-mentioned lens sheet is relaxed when release of the above-mentioned lens sheet is performed for the above-mentioned reverse release portion.

(3) In the production of a lens sheet having a reverse release portion where the molding tool is engaged with the lens sheet when the lens sheet molded by the molding tool is peeled from the molding tool in a constant direction by flexing the lens sheet, a device used for production of a lens sheet consisting of a molding tool made in the form of a roll or belt,

a release roll used for releasing the above-mentioned lens sheet molded on the above-mentioned molding tool, and

a release roll positioning means used for moving the above-mentioned release roll away from the curved side of the above-mentioned molding tool so that the above-mentioned molding tool curvature is utilized for release of the above-mentioned reverse release portion by means of repositioning the release roll.

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3. Detailed description of the invention

[Field of industrial application]

The present invention pertains to a lens sheet production method suitable for continuous production of lens sheets used for transmission type screens incorporated into rear projection screens, and the production machine thereof.

[Prior art]

In the past, circular Fresnel lens sheets for transmission screens have been produced one at a time by press molding an acrylic resin.

Fig. 8 is a drawing that shows the release process of a Fresnel lens sheet.

Concentric circular grooves are formed on the lens surface of a circular Fresnel lens sheet upon molding. Thus, when peeling of Fresnel lens sheet 32 from molding tool 31 is done in a constant direction, peeling can be easily achieved until the center region 31a of the molding tool is reached (Fig. 8A).

Engagement of peaks 31b of molding tool 31 and peaks 32a of Fresnel lens sheet 32 and occurs after passing beyond center area 31a of the molding tool and release is difficult (Fig. 8B).

In the past, removal of the Fresnel lens sheet has been done slowly toward the center area from the four corners of the Fresnel lens sheet so as to prevent reverse releasing and to make peeling easy.

However, in the above-mentioned manufacturing method, it is necessary to remove the Fresnel lens sheet from the molding tool one at a time, and automation of the release process is difficult, and production efficiency is low and production cost is high.

Meanwhile, as a method used for production of lenticular lenses, etc. with an absence of reverse releasing, a method wherein photopolymerization process is used can be mentioned. In said method, an ionizing radiation curing resin such as ultraviolet curing resin or electron beam curing resin is poured into the space between the molding tool and a base film, ionizing radiation such as ultraviolet or electron beam is applied to cure the resin, then, the molded lens sheet is transferred in a constant direction and release is performed with a release roll.

[Problems to be solved by the invention]

However, half of the lens sheet undergoes reverse releasing at the release process in the continuous production of a circular Fresnel lens sheet when the above-mentioned photopolymerization method is used; thus, application is not possible

The purpose of the present invention is to provide a method of producing a lens sheet suitable for continuous production of lens sheets used for transmission type screens incorporated into rear projection screens, and the production machine thereof.

[Means to solve the problem]

The present invention is a method where peeling is performed utilizing curvature on the molding tool side when the above-mentioned lens sheet forms the above-mentioned reverse release portion in the production of a lens sheet having a reverse release portion where the molding tool is engaged with lens sheet when the lens sheet molded by the molding tool is peeled from the molding tool in a constant direction by flexing the lens sheet.

Furthermore, production of a lens sheet characterized by the fact that the method consists of a resin coating process wherein a ionizing radiation curing resin is coated in the space between a lens molding tool having curvature in least one area, a lens molding process wherein ionizing radiation is applied to the above-mentioned ionizing radiation curing resin to cure and molding of the above-mentioned lens sheet is achieved, a release process wherein the above-mentioned lens sheet is released as flexing is performed for the sheet, and the sheet is released from the curved side of the above-mentioned molding tool in such a manner that the curvature of the sheet on the side of the above-mentioned lens sheet is relaxed when the above-mentioned lens sheet forms the above-mentioned reverse release portion in the production of a lens sheet having a reverse release

portion where the molding tool is engaged with lens sheet when the lens sheet molded by the molding tool is peeled from the molding tool in a constant direction by flexing the lens sheet.

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Furthermore, the present invention is a device for production of a lens sheet consisting of a molding tool made of a roll or belt, a release roll used for releasing the above-mentioned lens sheet molded by the above-mentioned molding tool, and a release roll positioning means used for moving the above-mentioned release roll away from the curved side of the above-mentioned molding tool when the above-mentioned release roll reaches the above-mentioned reverse release portion in a lens sheet production process having a reverse release portion wherein the molding tool is engaged with lens sheet when the lens sheet molded by the molding tool is peeled from the molding tool in a constant direction by flexing the lens sheet.

[Work of the invention]

According to the present invention, interference of the peaks of the lens molding tool and lens sheet can be prevented and releasing from the molding tool can be easily achieved since the release is done utilizing curvature of the molding tool on the reverse release portion of the lens sheet.

Therefore, continuous releasing in a constant direction is made possible in the production of a lens sheet having concentric circular grooves as in the case of a circular Fresnel lens sheet.

[Application Examples]

In the following, application examples are explained in detail with reference to the drawings.

Fig. 1 is a drawing that shows production of lens sheet 8 according to the method of the present invention.

The above-mentioned lens sheet production method is used in the production of a lens sheet having a reverse release portion 2a, for example, a circular Fresnel lens sheet, where molding tool 1 and lens sheet 2 are engaged and release is difficult at the time of releasing the molded lens sheet from the molding tool utilizing the curvature of the lens sheet.

As shown in Fig. 1A, when the lens sheet is a circular Fresnel lens sheet, removal of the lens sheet from the molding tool is done up to the center by a releasing means 3 such as a release roll by flexing the lens sheet.

Then, for the reverse release portion 2a of the lens sheet, flexing of the lens sheet is reduced using a method such as changing the position of the release means 3 and releasing is achieved utilizing the curvature of the molding tool. In order to achieve state shown in Fig. 1B for release of the lens sheet, in addition to changing the position of the release means, a guide such as a lever is used and guiding is done so that the lens sheet follows a straight line or at least the degree of curvature is reduced.

In this case, as the method used for production of the lens sheet, the extrusion method, casting method, photopolymerization method, etc. can be used.

When extrusion molding is performed, and the lens sheet is cooled to a temperature slightly below the softening temperature of the resin, a further improvement in removal can be achieved. For this reason, it is desirable when many cooling rolls or an endless belt is used in the area between the molding position and the release position. When a thermoplastic resin is used,

it is not necessary to use the base film required in the case of photopolymerization described below.

A lens sheet production method utilizing a photopolymerization process and the machine used for production are explained below.

Fig. 2 is a process flow chart for an application where the photopolymerization process is used in the lens sheet production process of the present invention.

Fig. 3~Fig. 5 show an application example of lens sheet production by the method of the present invention using a photopolymerization process; Fig. 3 shows the arrangement of the various rolls, Fig. 4 shows the molding tool, and Fig. 5 is an explanatory drawing showing the release process.

In production method shown in the application example above, as shown in Fig. 2, the process consists of resin coating process step 101, a lens molding process step 102, and a release process step 103.

Resin coating process step 101 is the process step wherein coating of an ionizing radiation curing resin in the space between the lens molding tool having curvature in at least one area and the base film is done.

Lens molding process step 102 is the process step wherein irradiation of the ionizing radiation curing resin is done to cure the resin and molding of the lens sheet is accomplished.

[p. 4]

Release process step 103 is the process step wherein removal of the lens sheet is done by flexing it; then, the curvature of the lens sheet is reduced for the reverse release portion of the

lens sheet, and removal of the lens sheet is carried out for the reverse release portion by the curvature of the molding tool.

Furthermore, as shown in Fig. 3, the production machine used in the above-mentioned application example has a structure comprising molding roll 4, nip rolls 5 and 6, release roll 7, and release roll shifting device 11, etc.

In the following, the function and structure of the production machine are explained according to the production method of the above-mentioned application example.

A base film BF coated with a primer is inserted between molding roll 4 and nip roll 5, and a urethane acrylate based UV curing resin 9 is applied in the valley between the molding roll and nip roll from the top by a curtain coater not shown in the figure (resin coating process step 101).

For the molding roll 4, die pattern 4a wrapped around the roll is used. As shown in Fig. 4A, die pattern 4a is produced by machining a brass sheet with a thickness of 1 mm fastened to a base sheet with a thickness of 15 mm so as to produce a Fresnel lens sheet. The above-mentioned die pattern 4a is removed from the base sheet and wrapped around the roll, and grooves 4a1 are formed parallel to the transport direction of the base film as the above-mentioned roll is rotated (Fig. 4B). The above-mentioned grooves 4a1 are made into a non-light transmitting portion produced by a converging lenticular lens sheet described below, and air bubbles inside the UV resin 9 are purged by the molding roll 4 and nip roll 5 at the time of molding so as to prevent air bubbles from remaining inside the molded lens sheet.

In this case, the molding roll can be produced by molding a photopolymer, thermosetting resin, or two-component curing resin, or forming a resin by machining and wrapping the

resulting resin mold onto a roll. Furthermore, when it is possible to provide sufficient time for compression of the UV resin with a nip roll, a standard circular Fresnel lens sheet molding without the above-mentioned vertical grooves can be used as well.

Subsequently, ultraviolet is applied to the space between the nip rolls 5 and 6 from the UV lamp 10, curing of the coated UV curing resin 9 is achieved, which is then applied to a base film to produce a lens sheet (lens molding process step 102).

When a photopolymerization process is used for production of the lens molding, curing of the UV resin in a short time is facilitated; thus, continuous production can be easily achieved.

Furthermore, excessive heat is not applied to the mold of the molding roll 4 itself; thus, resin molds can be produced that can be easily duplicated. The duplicates can be produced by forming a reverse mold made with a photopolymer, thermosetting resin, etc. using a die, and the resin mold is produced from the reverse mold by means of a photopolymerization process, casting process, etc.

Furthermore, depending on the type of UV curing resin used, flexibility of the lens sheet after curing can be achieved.

And finally, the lens sheet is removed from the molding roll 4 by release roll 7 (release process 103).

Release roll 7 is a roller used for releasing the lens sheet from the molding tool by flexing the molded lens sheet as shown in Fig. 3.

The above-mentioned release roll 7 is supported by release roll shifting device 11 and travels in the vertical direction with a constant range. Which makes changing of the position of the release roll possible at the time of releasing.

When flexing is performed for the lens sheet under the conditions shown in Fig. 5A, interference between the peaks 8a of lens sheet 8 and peaks 4a of molding tool 4 is reduced; thus, an adequate release can be achieved.

When releasing continues and passes the center area of the lens sheet, the state of engagement changes and interference between peaks 4a and peaks 8a takes place and the state becomes one of reverse release.

Therefore, from the center part of the lens sheet, the release roll shifting device 11 is used, and the support point of the release roll 7 is shifted upward as shown by the dotted lines in Fig. 3. As a result, as shown in Fig. 5B, the lens sheet side becomes flat, and releasing can be achieved utilizing curvature of the molding roll 4. In other words, even when releasing is done in a constant direction for a lens having a concentric circles, as in the case of circular Fresnel lens sheet, reverse release does not occur; thus, damage to the lens sheet can be prevented.

[p. 5]

Furthermore, when the above-mentioned continuous release is possible, production of a lens sheet can be achieved by means of photopolymerization method, thus, production of Fresnel lens sheet can be done continuously and efficiently, and as a result, production cost can be reduced.

Fig. 6 and Fig. 7 show different application examples of devices of the present invention used for production of lens sheets.

In the application example shown in Fig. 6, instead of the above-mentioned molding roll 4, molding belt 12 made of an endless belt including a lens molding tool is used.

In the production device of the above-mentioned application example, molding belt 12 is

loops around rolls 13A and 13B, and nip roll 15 is arranged near roll 13A and release roll 19 is arranged near roll 13B, respectively.

Base film BF is guided over the top of nip roll 15 downward and coating of UV resin 17 is achieved, and ultraviolet is applied by a UV lamp to produce a Fresnel lens (resin coating process step 101 and lens molding process step 102).

After molding of the lens, the belt 17 is released from the lens sheet 16 (release process step 103).

In this case, releasing roll 19 is positioned as shown by the solid line and release is achieved up to the center of the lens sheet.

Upon reaching the center of the lens sheet, the engagement of the lens sheet and belt is such that a reverse release state occurs; thus, the release roll is shifted to the position shown by the dotted line by means of release roll shifting device 20 and release is continued.

Therefore, release of the lens sheet from the belt can be achieved without damaging the lens sheet.

Furthermore, when molding belt 12 is used as a molding tool, direct extrusion molding of a thermoplastic resin can be achieved without using base film BF.

In the application example shown in Fig. 7, molding belt 21 is used for the lens molding tool as in the case of the application example of Fig. 6, but in this case, molding belt 21 is looped around three rolls 22A, 22B and 22C.

When the three rolls 22A, 22B and 22C of the belt are backed by nip rolls 23 and 24, the distance between molding process of the lens sheet and release process can be extended; thus,

thorough cooling of the molded Fresnel lens is made possible. Therefore, releasing can be achieved after adequate curing of the lens sheet.

The present invention is not limited to the above-mentioned application examples and many modifications within the range of the present invention can be performed.

The case where molding of a Fresnel lens on one surface of the base film is explained above, but a process where molding of a lenticular lens on the opposite side of the above-mentioned Fresnel lens using photopolymerization method can be added. In the lens sheet produced as explained above, the distance between the vertical diffusion lens and Fresnel lens can be reduced, thus, the resolution can be increased.

Furthermore, an increase in contrast is made possible when a front screen 8 is applied with a black-colored adhesive to the projection member 8b consisting of a Fresnel lens sheet molded with vertical grooves 4a1 formed on the lens molding roll 4 shown in Fig. 4 for purging of air bubbles on the Fresnel lens surface.

[Effect of the invention]

As explained in detail above, according to the present invention, when releasing is performed in a constant direction, a reverse release state can be avoided. As a result, continuous production is made possible for a lens sheet having a reverse release region.

4. Brief description of figures

Fig. 1 is a drawing that shows a production process for lens sheet according to the method of the present invention.

Fig. 3~Fig. 5 show application examples of production of lens sheet of the present invention using a photopolymerization process, and Fig. 3 shows the arrangement of each roll, Fig. 4 shows the molding tool, and Fig. 5 shows an explanatory drawing of the release process.

[p. 6]

Fig. 6 and Fig. 7 show different application examples of production devices used for production of lens sheets of the present invention.

Fig. 8 shows the release process of the Fresnel lens sheet.

101: Resin coating process

102: Lens molding process

103: Release process

4: Molding roll

5, 6, 15, 23 and 24: Nip rolls

7, 19: Release rolls

BF: Base film

8, 16: lens sheet

9, 17: UV resin

10, 18: UV lamp

11, 20: Release roll shifting device

12, 21: Molding belts

13A, 13B, 22A, 22B and 22C: Rolls

Agent: Hisao Kamata, Patent attorney

Fig. 1A

1: molding tool

1a: center region

2: lens sheet

3: Release means

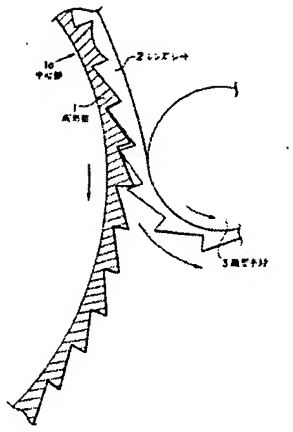


Fig. 1B

1: molding tool

1a: center region

2: lens sheet

3: Release means

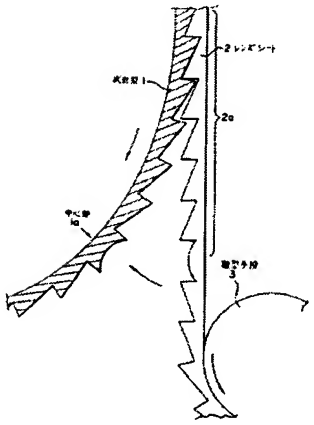


Fig. 2

101: Resin coating process

102: Lens molding process

103: Release process

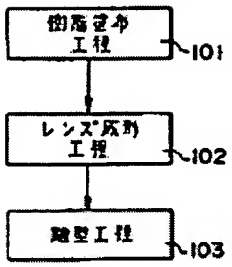


Fig. 3

4: Molding roll

5: Nip roll

6: Nip roll

7: Release roll

8: lens sheet

9: UV resin

10: UV lamp

BF: Base film

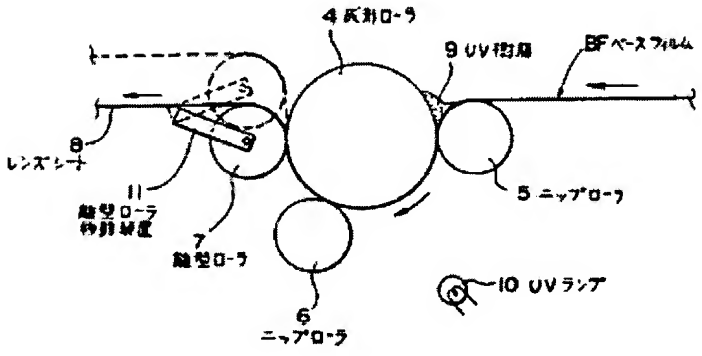
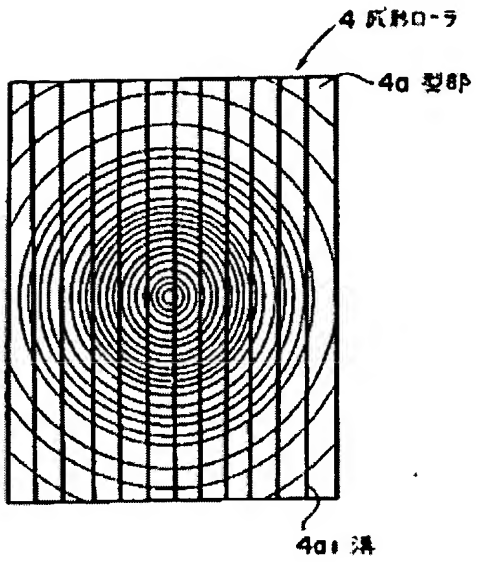


Fig. 4A



4: Molding roll

4a: Mold pattern

4a1: Groove

Fig. 4B

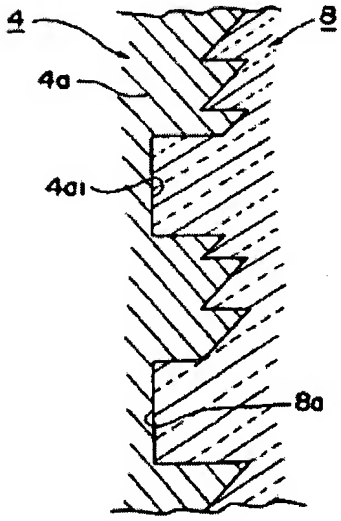


Fig. 5A

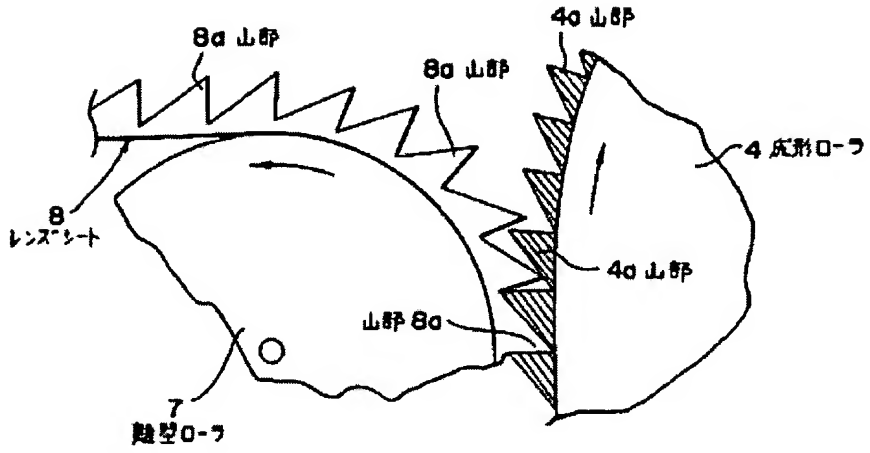
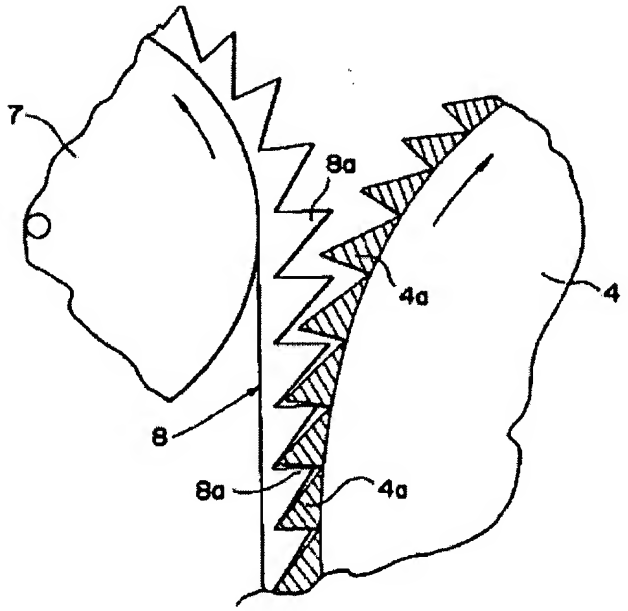


Fig. 5B



4: Molding roll

4a: Peak

7: Release roll

8: Lens sheet

8a: Peak

Fig. 6

12: Mold belt

13A: Roll

13B: Roll

15: Nip roll

16: Lens sheet

17: UV resin

18: UV lamp

19: Release roll

20: Release roll positioning device

BF: Base film

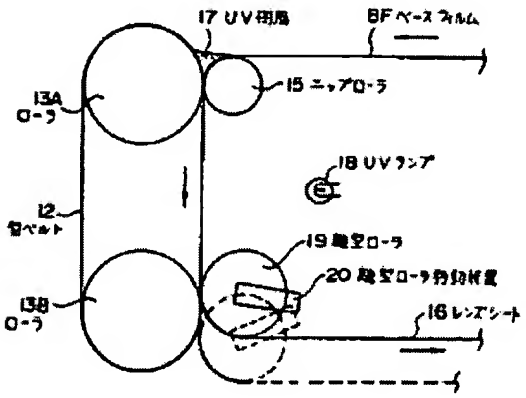


Fig. 7

16: Lens sheet

17: UV resin

18: UV lamp

19: Release roll

20: Release roll shifting device

21: Belt mold

22A: Roll

22B: Roll

22C: Roll

23: Nip roll

BF: Base film

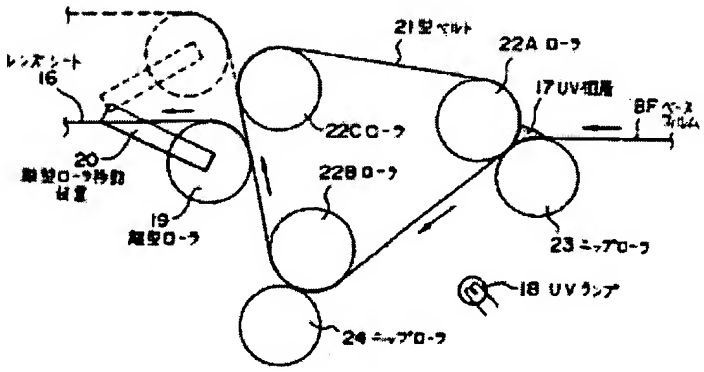


Fig. 8A

31: Molding tool

31a: Center region

32: Lens sheet

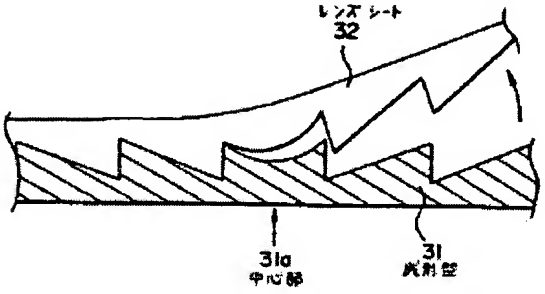


Fig. 8B

31: Molding tool

31a: Center region

31b: Peak

32: Lens sheet

32a: Peak

31a: Center region

32: Lens sheet